ORIGINAL RESEARCH ARTICLE

Case-control study on risk factors of low birth weight in a tertiary care hospital, Kerala

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Abstract:

Background & Objectives: World Health Organization defines low birth weight as birth weight of less than 2500 grams irrespective of gestational age. Low birth weight is the single most important risk factor of infant mortality in developing countries such as India. As Kerala enjoys a unique position among other state of India because of its distinct demographic and health indicators, it is necessary to identify the risk factors of low birth weight operating in this state. Hence this study was undertaken to identify medical and social risk factors of low birth weight among infants delivered at a tertiary care hospital of Kannur, Kerala. **Materials and Methods:** It was a case-control study carried out at Kannur Medical College and Hospital, Kannur District, Kerala. The study period was from October 2015 to March 2016. The study involved 110 cases (mothers who delivered a child with birth weight of <2500 grams) and 220 controls (mothers who delivered a child with birth weight of ≥2500 grams). Using medical records, all the deliveries that have taken place in the Hospital in the past 3 years (1st Jan 2013 to 31st Dec 2015) were line listed separately as cases and controls. Simple random sampling method was used to select the required number of cases and controls. Data was collected using a pre-tested, structured questionnaire and data analysis was done on SPSS version 17. **Results:** The study found that ante-natal visits in a private hospital and complete intake of iron and folic acid tablets were protective against low birth weight. Diseases such as anaemia during pregnancy, gestational hypertension and pre-term delivery were identified as risk factors of low birth weight in the study population. Regarding anthropometric measurements, it was observed that lower pre-pregnancy weight (<55 kgs) and height (<155 cm) of the mother resulted in low birth weight of newborn. **Interpretation & Conclusion:** As anaemia during pregnancy and gestational hypertension are important risk factors of low birth weight, all pregnant women must be screened preferably on a monthly basis for their early detection and treatment. Pregnant women must be educated by the health staff regarding the benefits of completing the course of iron and folic acid tablets. High risk approach should be adopted when dealing with mothers who are of shorter height (<155 cm), so as to closely monitor and treat them, thus preventing low birth weight in the newborns.

Key Words: Low birth weight; risk factors; Kerala; anaemia; gestational hypertension.

INTRODUCTION

Low birth weight (LBW) is the single most important risk factor of infant mortality in developing countries. It involves two main subgroups, those born prematurely and those with foetal growth retardation. World Health Organization (WHO) defines low birth weight as birth weight of less than 2500 grams irrespective of gestational age.[1] This cut-off value is based on epidemiological observations that newborns weighing less than 2500 grams are around 20 times more likely to die as compared to newborns weighing more than 2500 grams.[2]

Globally an estimated 15.5% of newborns have birth weight less than 2500 grams. The level of low birth weight in developing countries (16.5%) is more than double the level in developed countries (7%).[1] India alone accounts for 40% of low birth weight births in the developing world and more than half of those in Asia. There are more than 8 million infants born with low birth weight in India. The estimated prevalence of low birth weight in India and Kerala is 20% and 18% respectively.[3-4]

The United Nations Millennium Declaration on Millennium Development Goals (MDGs) placed health at the heart of development and identified woman and child health as a high priority area. In order to achieve the goals

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of reducing child mortality, it is necessary to focus on reducing low birth weight as it is the major contributor of under-five child mortality.

The low birth weight of newborns is closely associated with neonatal mortality and morbidity, inhibited growth and cognitive development, and chronic diseases such as coronary heart disease, stroke, hypertension and non-insulin dependent diabetes mellitus later in life.[5-6] Low birth weight is a multifactorial phenomenon. Various medical and social factors such as mother's age, education, socioeconomic status, anaemia, diabetes mellitus, hypertension, antenatal visits, health care provider, family support, mental stress, customs and government health policies have been implicated in determining the weight of newborn.[7-12] The risk factors are not the same throughout the country and there are regional variations.

Kerala is a unique state of India which is having different demographic and health indicators compared to the National average. It is imperative to identify the dominant risk factors of LBW operating in the Kerala State, so that this information can be utilized for preventive and control measures. Case control study is an appropriate design to study the risk factors of LBW and hence this was adopted to identify the medical and social risk factors contributing to low birth weight among infants delivered at Kannur Medical College Hospital, Kerala.

MATERIALS AND METHODS

It was a Hospital based Case-control study which was carried out at Kannur Medical College and Hospital, Kannur District, Kerala State. It is a private Medical College with 750 beds and it is staffed with adequate specialist in all medical departments. The study period was from October 2015 to March 2016. The study population included all the deliveries that have taken place in Kannur Medical College from 1st January 2013 to 31st December 2015. Case was defined as "a woman who delivered a child with birth weight of less than 2500 grams" and control was defined as "a woman who delivered a child with birth weight of equal to or more than 2500 grams".

Sample size was calculated using Openepi software version 3. Proportion of anaemia during pregnancy of 40% was considered for sample size calculation at 95% confidence level and 80% power. The total sample size required was 330, which includes 110 cases and 220 controls.

The sampling method was as follows; all the deliveries that have taken place in the Kannur Medical College Hospital in the past 3 years (1st Jan 2013 to 31st Dec 2015) were line listed separately as cases and controls. The cases and controls not meeting the selection criteria were excluded from the list. Next using simple random sampling method, a computer generated list of required number of cases and controls was produced. An inclusion criterion was singleton pregnancies delivered in Kannur Medical College Hospital. Incomplete records and still births were excluded from the study. The ethical clearance was taken from the Institutional Ethical Committee (Ethical Committee/KMC/1/2016).

Data was collected from records maintained in the Medical Record Department of the Hospital. Using a structured questionnaire details of selected medical, social and demographic factors affecting birth weight were taken from the records. Smoker was defined as a woman who smoked tobacco products during her pregnancy period. A woman was considered to be an alcoholic, if she consumed alcohol (either daily or occasionally) in any form during the period of pregnancy. Anaemia was defined and classified according to WHO criteria.[13] Non-pregnant women having haemoglobin (Hb) < 12 gm/dl and pregnant women having haemoglobin < 11 gm/dl were considered as anaemic. Report of the national high blood pressure education program working group on high blood pressure in pregnancy was used to classify and define hypertension.[14] Hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg before pregnancy or 20 weeks gestation. Gestational hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥90 mmHg without proteinuria in a women who was normotensive at 20 weeks gestation. A woman was considered to be diabetic if the fasting plasma glucose was ≥ 126 mg/dl or 2 hour plasma glucose was ≥ 200 mg/dl.[15] Gestational diabetes mellitus was defined as any degree of glucose intolerance with onset or first

recognition during pregnancy.[16] Pre-term delivery was defined as birth of child before completion of 37 weeks of gestational age. Birth weight was defined as the first weight of the newborn recorded soon after birth.

The data collection was done by the chief investigator along with two trained interns who were posted in the department of community medicine. Prior to the main study, a pilot study was conducted on 10 cases and controls each, to check for any modifications required in the questionnaire. After the pilot study, it was observed that some originally intended study parameters such as family support, consumption of smokeless tobacco, accessibility and distance to the nearest health centre were either not available or were incompletely documented in the medical records. Hence, these parameters for which adequate data was unavailable were removed from the study questionnaire.

Data entry and analysis was done on SPSS version 17. Microsoft word and Excel have been used to generate graphs and table. As mother's age may act as a confounder, group matching for mother's age was done for cases and controls at analysis stage. Results of categorical variables are presented as number and percentage, whereas continuous variables are presented as mean and standard deviation. Student t test (two tailed, independent), chi-square test and regression analysis has been used to find the significance of study parameters. p value less than 0.05 was considered to be statistically significant.

RESULTS

The study included 330 women (110 cases and 220 controls) who had delivered in Kannur Medical College. Regarding socio-demographic parameters, it was observed that more than 80% of the women in both the cases and control groups were from rural areas [Table 1]. With respect to the education, it was found that 74% of the cases and 65% of the controls had completed 10th std. It was also observed that 98% of the study women were literates. With regard to marriage practices it was found that more than 98% of women in both the groups were currently married. The diet preference of vast majority of the study population was non-vegetarian diet. Tobacco and alcohol intake was found to be very low in the study population (less than 5% in both the groups). None of the study socio-demographic parameters were found to be significantly associated with low birth weight of the newborn.

Regarding medical factors, it was observed that ante-natal visits in a private hospital and complete intake of iron and folic acid tablets were protective against low birth weight [Table 2]. Diseases such as anaemia during pregnancy, gestational hypertension and pre-term delivery were identified as risk factors of low birth weight in the study population. About anthropometric measurements, it was observed that lower pre-pregnancy weight (<55 kgs) and height (<155 cm) of the mother resulted in low birth weight of newborn [Table 3].

DISCUSSION

It was a case-control study carried out in Kannur Medical College Hospital to identify the risk factors of low birth weight among deliveries which took place in the Institute. A total of 110 cases and 220 controls were included for the study and data was collected from medical records department.

Mother's education is said to be an important factor influencing the health of their children.[17] Educated women are expected to have a sufficient working knowledge about the do's and don'ts related to health care,

Table 1: Distribution of cases and controls based on socio-demographic characteristics and personal habits

Study variable	n (330)	Cases (110)		Controls (220)		Odds Ratio	95% C.I for OR	p value
		No.	*%*	*No.*	*%*			
Rural Residence	268	92	83.6	176	80.0	1.28	0.70-2.34	0.458
Education < 10 std.	105	29	26.4	76	34.5	0.68	0.41-1.13	0.133
Currently married	325	109	99.1	216	98.2	2.02	0.22-18.28	0.668
Non-vegetarian diet	325	108	98.2	217	98.6	0.75	0.12-4.54	0.750
Smoking tobacco	6	4	3.6	2	0.9	4.11	0.74-22.81	0.80
Alcohol consumption	11	5	4.5	6	2.7	1.69	0.51-5.69	0.516
Strenuous physical work during pregnancy	15	7	6.4	8	3.6	1.80	0.63-5.10	0.273

which might result in better health status for themselves and for their children. The present study found no association between mother's education level and low birth weight among newborn. This could be due to the fact that most women are well educated in Kerala state and there was not much of a difference in the education status between cases and controls.

Marriage is a universal phenomenon in India. The current study found that 98.5% of women, who delivered in the medical college, were married women. It can be expected that

Table 2: Distribution of cases and controls based on medical factors influencing birth weight

Study variable	n (330)	Cases (110) No.	%	Controls (220) No.	%	Odds Ratio	95% C.I for OR	p value
Less than 4 ANC visits	16	8	7.3	8	3.6	2.08	0.76-5.70	0.176
ANC visits in a private set up	286	84	76.4	202	91.8	0.29	0.15-0.55	0.001*
Started iron and folic acid tablets	325	107	97.3	218	99.1	0.33	0.05-1.99	0.338
Completed iron and folic acid tablets	283	88	80.0	195	88.6	0.51	0.27-0.95	0.034*
Anaemic before pregnancy	48	16	14.5	32	14.5	0.98	0.51-1.91	0.966
Anaemic during pregnancy	181	81	73.6	100	45.5	3.35	2.03-5.53	<0.001*
Chronic hypertension	14	7	6.4	7	3.2	2.07	0.71-6.05	0.245
Gestational hypertension	31	17	15.5	14	6.4	2.69	1.27-5.69	0.015*
Chronic diabetes mellitus	11	5	4.5	6	2.7	1.70	0.51-5.69	0.516
Gestational diabetes mellitus	20	9	8.2	11	5.0	1.69	0.68-4.22	0.327
Pre-term delivery	66	48	43.6	18	8.2	8.68	4.71-16.0	<0.001*
Spacing of < 3 years	74	29	35.8	45	30.8	1.25	0.71-2.22	0.463

*p value is significant

Table 3: Distribution of cases and controls based on anthropometric measurements

Study variable	n (330)	Cases (110) No.	%	Controls (220) No.	%	Odds Ratio	95% C.I for OR	p value
Pre-pregnancy weight ≤55 kgs	146	98	89.1	48	21.8	29.26	14.83-57.73	<0.001*
Maternal height ≤ 155 cms	119	71	64.5	48	21.8	6.52	3.94-10.81	<0.001*

*p value is significant

Table 4: Table showing multivariate logistic regression analysis

Study variables	β co-efficient	Odds Ratio	95% C.I. for OR Lower	Upper	p value
Place of ante-natal visit (Private hospital)	-1.056	0.35	0.15	0.81	0.015*
Complete intake of iron and folic acid tablets	-0.615	0.54	0.23	1.29	0.166
Anaemia during pregnancy	1.275	3.58	1.95	6.58	<0.001*
Gestational hypertension	1.248	3.48	1.28	9.45	0.014*
Pre-term delivery	2.140	8.49	4.06	17.79	<0.001*
Pre-pregnancy wt (<55 kgs)	0.148	1.16	1.10	1.23	<0.001*
Maternal height (<1.55 m)	14.019	1.22	1.09	1.53	<0.001*

*p value is significant

unmarried women, who do not have family support may have physical, mental and financial difficulty leading to poor health in them and their children. A study conducted by Sung JF et al. in Atlanta, Georgia found the crude LBW rate among infants born to unmarried mothers was about twice the rate among infants born to married mothers (132.8 vs. 63.9 per 1000 live births).[18] As most women were married in the present study, the impact of being single mother on low birth weight could not be rightly assessed. With regard to dietary practices in most part of Kerala, it is observed that a large proportion of people consume non-vegetarian food, irrespective of their religion and caste. The present study found the diet preference of around 98% of the women was non-vegetarian. No association was present between type of diet and low birth weight.

Regarding ante-natal visits, it is recommended that the pregnant women must have at least 4 visits to the doctor during her pregnancy period.[19] In Kerala, there is a general trend that most deliveries take place in the hospital and the pregnant women visit their doctors regularly. The present study found the most of the women in the case and control groups had more than the recommended 4 ante-natal visits, thus the number of ante-natal visits was not found to be risk factor for low birth weight. But at the same time it was observed that the women who had their ante-natal visits in the private medical college had better pregnancy outcomes as compared to the women who visited government health set up. This could be due to better availability of senior gynaecologist and specialist in the allied departments of the medical college.

The present study found that baring a few, almost all women had started the iron and folic acid tablets but only around 80% women among cases and 89% women among controls completed the recommended schedule of tablets. Some women stopped the tablets without completing the course either due to ignorance or due to side effects such as vomiting and stomach pain. The study found that completing the course of iron and folic acid tablets rather than just initiating them is a factor preventing occurrence of low birth weight in the newborns. A study conducted by Khanal V et al. in Nepal had inferred that mothers not consuming iron supplementation during their pregnancy were more likely to have LBW infants [OR=1.839; 95% CI (1.282-2.363)].[20] In the present study on conducting a multivariate regression analysis, it was observed that, anaemia was significantly associated with low birth weight and not iron and folic acid intake [Table 4]. This is plausible, as deficiency of iron and folic acid causes anaemia which in turn results in low birth weight.

Tobacco smoking by women is not a social practice in North Kerala. The present study observed that the vast majority of the women were non-smokers and found no association between tobacco smoking and low birth weight. In contrast a study conducted by Magee BD et al. on role of smoking in low birth weight, found that, LBW was 58% more likely among smokers than non-smokers.[21] Thus tobacco smoking may be a risk factor in those communities, where women smokers are more in number but not in the current study population. Similar to tobacco smoking, majority of the cases and controls were found to be non-alcoholic. Alcohol consumption either on regular or occasional basis is uncommon in most areas of Kerala. In the present study those women who consumed alcohol mostly had it occasionally. Excessive physical work is a common reason for abortion and low birth weight in India. A study conducted by Dwarkanath P et al. in Bangalore, Karnataka found physical activity, especially in the first trimester to be associated with low birth weight [OR=1.58; 95% CI (1.02-2.44)].[22] Fortunately the present study found less than 5% of women engaged in strenuous work. Hence there was no significant association found between strenuous work and low birth weight in the study population.

It is estimated that 30% to 70% of non-pregnant women are anaemic in our country.[23-27] During pregnancy the iron and folic acid requirement is increased to meet the growing demand of the foetus. Thus if a women is already anaemic in pre-pregnant state then, there is a high probability that the anaemia may worsen during pregnancy and this may lead to low birth weight in the newborn. In the present study, it was observed that around 15% of women in both the study groups were anaemic before pregnancy. Pre-pregnancy anaemia was not found to be a risk factor of low birth weight.

However, anaemia during pregnancy was found to a significant risk factor of low birth

weight. Similar finding have been reported by Levy A et al. in Israel and Ahmed MO et al. in Pakistan, where they found anaemia during pregnancy to be significantly associated with low birth weight.[28-29] When a women is anaemic during pregnancy, inadequate amount of oxygen is delivered to the growing foetus, which effects the foetal growth and functioning, thus resulting in low birth weight and premature birth. It has been mentioned earlier in this study that regular intake of iron and folic acid tablets is protective against low birth weight. The regular intake of these tablets will prevent anaemia and safeguard from low birth weight.

High blood pressure leads to many complications in the mother and growing foetus.[30] A study conducted by Fang J et al. in New York concluded that maternal hypertension (chronic and gestational) is an important risk factor for low birth weight.[31] In the present study 6.4% of case and 3.2% of controls were suffering from chronic hypertension. No association was present between chronic hypertension and low birth weight. The present study found gestational hypertension as a factor responsible for low birth weight. Hypertension causes undernutrition in the foetus as a result of utero-placental vascular insufficiency, which leads to growth retardation.

Chronic diabetes mellitus and gestational diabetes may result in increased size of the newborn.[32,33] It is also important to note that uncontrolled diabetes may result in premature birth and low birth weight due to early induction of labour or premature rupture of membranes.[34] The present study found no association of diabetes and low birth weight.

As India is a developing country, poverty and malnutrition are common issues in the population. Few studies have found that, with increase in the number of children, the health of the mother may deteriorate resulting in lower birth weight of the newborns.[35] The present study found no association between the number of children delivered and low birth weight. This could be accounted for by the fact most women being economically stable had maintained their nutrition. A possible confounder here could be the socio-economic status of the study women. As the study was done in a private medical college, people belonging to lower economic class might not have accessed care from the private hospital. Thus a community based study will be a better design to further explore the relationship between number of deliveries and low birth weight.

Pre-term delivery is an established risk factor for low-birth weight.[7] The present study findings were also on similar lines where it was observed that among cases 44.6% were pre-term deliveries whereas among controls only 8.2% were pre-term deliveries. In general, the weight of the newborn male is more than the newborn female. In the present study sex distribution was similar in both the groups, thus avoiding any confounding effect.

The Ministry of Health and Family Welfare recommends that there should be a space of 3 years between consecutive pregnancies. This will give an opportunity for the mother to restore her health to the optimum condition. The study observed that majority women were following the advice on spacing between children. There was no association between spacing between pregnancies and low birth weight among newborns.

With reference to pre-pregnancy weight, it was observed that the mean pre-pregnancy weight was 53.75 kgs and 57.08 kgs respectively for cases and controls. On applying unpaired t-test this difference was found to be statistically significant. Women with lower pre-pregnancy weight will have a higher tendency to be undernourished which later results in lower birth weight of the newborns.[36] The study also observed that pre-pregnancy weight of <55 kgs to be a highly significant risk factor of low birth weight. Thus a cut-off value of 55 kgs may be used in Kerala state while screening for high risk pregnancy. Other studies conducted by Mumbare SS et al. in Maharashtra and Kumar SG et al. in Karnataka found pre-pregnancy weight of <55 kgs and <45 kgs respectively, to be a risk factor for low birth weight.[8-9]

The height of the mother is also considered to be linked to weight of the newborn, as previous studies have shown a positive correlation between them.[8] In the present study the mean height of the mothers in the cases and controls group was 154.52 cm and 157.0 cm respectively. Thought the mean difference was only -2.48 cm, this was found to be statistically significant. A person's height depends on the height of the family members, mainly the parents.

A shorter mother has a higher tendency to have a smaller child, hence lesser the birth weight. Using a cut-off value of 155 cm, it was observed that women with height below this level had a higher probability of delivering a low birth weight newborn. This cut-off value of 155 cm for height of the mother may be considered while screening for high risk pregnancy in Kerala. A similar study conducted by Mumbare SS et al. in Maharashtra found maternal height <145 cm to be a risk factor of low birth weight.[8]

CONCLUSION AND RECOMMENDATION

It was observed that, around 74% of the women who delivered low birth weight infants had anaemia, which highlights the need to screen women on a monthly basis during pregnancy to detect anaemia early and treat it. Education about diet rich in iron and folic acid along with regular intake of iron and folic acid tablets will help in bringing down the cases of anaemia during pregnancy. Gestational hypertension was associated with low birth weight, hence all pregnant women must get their blood pressure checked preferably on a monthly basis, so that women who have higher blood pressure can be identified early and treated.

As low pre-pregnancy weight of the mother was a cause of lower birth weight among newborns, women who intend to become pregnant must be educated to have a balanced diet and maintain their body mass index in the recommended range. After all a healthy mother brings forth a healthy child. A cut-off value of 55 kgs for pre-pregnancy weight may be used to screen high risk cases in Kerala.

Shorter height of the mother was identified as a non-modifiable risk factor for low birth weight. Women's height of <155 cm may be considered as high risk pregnancy in Kerala State. As it is a non-modifiable factor, a high risk approach as recommended by Ministry of Health and Family welfare needs to be undertaken and these women need to be monitored frequently and treated to prevent low birth weight.

LIMITATIONS OF THE STUDY

As the study was based on medical records, the role of few initially intended parameters such as family support to the pregnant women, accessibility and distance of nearest health centres on weight of the newborn could not be assessed. Pre-pregnancy weight was recorded based on the information given by the pregnant women, which may not be true. The cases and controls were considered to be suffering from chronic hypertension and diabetes based on the information they provided. It is possible that some women had these diseases but were not diagnosed due to absence of any screening on them. This might result in underestimating the role of chronic hypertension and diabetes on the birth weight of the newborn.

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